AMENDMENTS TO THE CLAIMS

This listing of claims will replace all prior versions, and listings, of claims in the application:

Listing of Claims

Claim 1 (currently amended): A method for forming a trench capacitor, comprising:

providing a semiconductor substrate, wherein a deep trench and a deep trench capacitor are formed therein, the deep trench capacitor having a node dielectric layer and a storage node, the node dielectric layer covering a sidewall and a bottom portion between the deep trench and the storage node of the deep trench capacitor, and the storage node filling the deep trench to a predetermined depth;

ion implanting the top portion of the deep trench [[to]] at a predetermined angle to form an ion doped area on a single sidewall of the semiconductor substrate and the top surface of the deep trench capacitor;

~~oxidizing the semiconductor substrate to form~~ forming an oxide layer on the ion doped area;

forming a sidewall layer ~~on the exposed semiconductor substrate~~ on the sidewall of the deep trench using the oxide layer as a mask, wherein the sidewall layer is isolated from the storage node of the deep trench capacitor;

removing the oxide layer;

forming a barrier layer on the ~~sidewall~~ interior of the deep trench and the sidewall layer; and

filling a conducting layer in the deep trench.

Claim 2 (original): The method for forming a trench capacitor of claim 1, wherein the ion source of the ion implantation is a gas mixture containing F, which promotes growth of the oxide layer.

Claim 3 (original): The method for forming a trench capacitor of claim 2, wherein the gas mixture containing F is fluorine gas.

Claim 4 (original): The method for forming a trench capacitor of claim 1, wherein the sidewall layer is an epi-silicon layer.

Claim 5 (original): The method for forming a trench capacitor of claim 1, wherein the material of the sidewall layer is the same as the semiconductor substrate.

Claim 6 (original): The method for forming a trench capacitor of claim 1, wherein the barrier layer is an oxide layer or a nitride layer.

Claim 7 (original): The method for forming a trench capacitor of claim 1, wherein the conducting layer is a poly layer.

Claim 8 (original): The method for forming a trench capacitor of claim 1, wherein the node dielectric layer is a silicon nitride layer.

Claim 9 (original): The method for forming a trench capacitor of claim 1, wherein the storage node is an n+ type doped poly.

Claim 10 (currently amended): A method for forming a trench capacitor, comprising:

providing a semiconductor substrate, wherein a deep trench and a deep trench capacitor are formed therein, the deep trench capacitor having a node dielectric layer and a storage node, the node dielectric layer covering a sidewall and a bottom portion between the deep trench and the storage node of the deep trench capacitor, the storage node filling the deep trench to a predetermined depth, and the deep trench has a first sidewall and a second sidewall;

ion implanting the deep trench top portion [[to]] at a predetermined angle to form an ion doped area on the semiconductor substrate of the first sidewall and the top surface of the deep trench capacitor;

oxidizing the semiconductor substrate to form a first oxide layer on the ion doped area and a second oxide layer on the second sidewall, wherein the thickness of the first oxide layer exceeds the thickness of the second oxide layer;

removing the second oxide layer to expose the semiconductor substrate of the second sidewall of the deep trench;

forming a sidewall layer on the second sidewall using the first oxide layer as a mask;

removing the first oxide layer to expose the semiconductor substrate of the first sidewall;

conformally forming a first barrier layer on the first sidewall, the sidewall layer, and the deep capacitor;

forming spacers on the first sidewall and a sidewall of the sidewall layer sequentially;

filling a first conducting layer in the deep trench;

etching back the first conducting layer and the spacer to a predetermined depth; and

conformally forming a second barrier layer on the first sidewall, the sidewall layer, and the first conducting layer, and the deep trench being filled with a second conducting layer.

Claim 11 (original): The method for forming a trench capacitor of claim 10, wherein the ion source of the ion implantation is a gas mixture containing F, which promotes growth of the oxide layer.

Claim 12 (original): The method for forming a trench capacitor of claim 11, wherein the gas mixture containing F is fluorine gas.

Claim 13 (original): The method for forming a trench capacitor of claim 10, wherein the sidewall layer is an epi-silicon layer.

Claim 14 (original): The method for forming a trench capacitor of claim 10, wherein the material of the sidewall layer is the same as the semiconductor substrate.

Claim 15 (original): The method for forming a trench capacitor of claim 10, wherein the first barrier layer is a nitride layer.

Claim 16 (original): The method for forming a trench capacitor of claim 10, wherein the spacer is an oxide layer or a nitride layer.

Claim 17 (original): The method for forming a trench capacitor of claim 10, wherein the first conducting layer is a poly layer.

Claim 18 (original): The method for forming a trench capacitor of claim 10, wherein the second barrier layer is a nitride layer.

Claim 19 (original): The method for forming a trench capacitor of claim 10, wherein the second conducting layer is a poly layer.

Claim 20 (original): The method for forming a trench capacitor of claim 10, wherein the node dielectric layer is a nitride silicon layer.

Claim 21 (currently amended): The method for forming a trench capacitor of claim [[1]] 10, wherein the storage node is n+ type doped poly.